REPORTS OF THE SWEDISH DEEP-SEA EXPEDITION. VOL I
THE SHIP, ITS EQUIPMENT, AND THE VOYAGE. NO. 2.

HOW THE "ALBATROSS" BECAME A RESEARCH VESSEL

BY

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[y first contact with Professor HANS PET-ERSSON on this matter was established in the iddle of the war, in the spring of 1943, at a little eeting in the home of the Chairman of the Bro-röm Shipping Concern, the late Mr HERBERT ACOBSSON. Dr PETTERSSON made an enthu-ıstic and fascinating speech about his plans r a scientific around-the-world-cruise. My vn immediate reaction, however, was that is had very little to do with maritime com-erce and shipping business.

Dr PETTERSSON, however, very soon appro-hed me in order to ascertain my opinion garding the advisability of choosing f. i. a lvage ship for the projected cruise. After ıving been informed of the many things Dr ETTERSSON intended to put into the research ssel, I had to express the view that the pro-osed ship was much too small and, further-ore, rather unsuitable for such a long cruise onsidering the type of the ship and her sea ualities. Little I imagined that Dr PETTERS-ON was to make my answer the starting point r a frontal attack, his next question being hether not any of the other ships of the ompanies might be more suitable, f. i. our aining ship ALBATROSS.

I dare say that no other ship of the Broström oncern is so dear to me as the ALBATROSS. he represents an idea about professional aining that I dreamed about during the sea-ring years of my youth and later had the nexpected opportunity to put before the rsighted management of a big shipping con-ern. Further, she was designed and built nder my superintendence and, finally, when the ship was completed I was chosen to act as her owner.

The building of the training ship had involved very heavy cost, not least on account of the high prices and the long time she had to be kept out of commission due to the war. As the hostilities were coming to an end I was eager to send the ship to sea, being urged both by a wish to have the training started and by my sense of economy. Good profits could be expected just then which could give the ship a good financial start, making it possible to pay off the cost before a depression in trade set in.

My first feeling, therefore, was something like this: Don't try to touch this favourite ship of mine, in any case not during the good conjunctures which very probably will come after the war!

However, against Professor PETTERSSON I could raise neither words convincing enough nor a poker face sufficiently masked to stop his avalanche-like interest for the ship. Nor could I easily deny that the ship no doubt would be most suitable for the purpose considering such things as space available, cruising range, sails as a stabilizing factor, bilge keels against rolling, etc. Moreover, the small engine power and the big area of sails made it possible to run the ship cheaper compared with ships of conventional types. Our first discussion, therefore, ended in a promise that I should closely investigate the possibilities for the owners of our companies to put the ship at the disposal of the projected scientific cruise.

It would undoubtedly be a deviation from

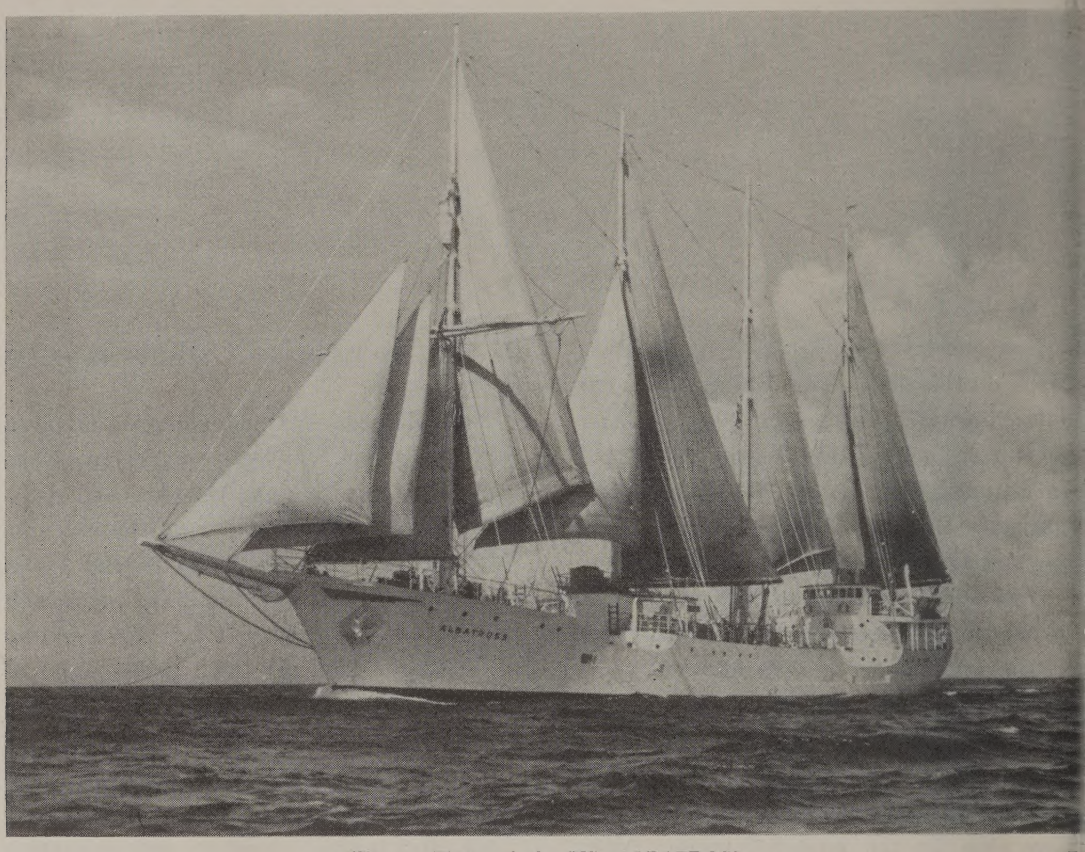


Fig. 1. Photo of the MS »ALBATROSS».

the real task of the ALBATROSS, e. g. to serve as a cargo carrying training ship, to employ the ship as a research vessel. However, from *training* point of view we thought that the theoretical education on the whole could be managed in accordance with the ordinary program, and that even the practical training should be very effective as the apprentices should assist in the scientific work such as deep-sea coring, sounding and trawling. The routine work on board during such a cruise was also expected to become rather demanding. The training of the engine-apprentices could be expected to be of the same extent as in normal traffic. The main drawback would be that no training in handling cargo could be given. On the other hand, the long time spent at sea would enable an increase of the theoretical education amongst others thanks to the scientists' willingness to give lectures on vario subjects, which also was done and is herel thankfully acknowledged. Consequently, it w considered that from the point of view training there should be no objections agair chartering the vessel for the purpose.

Economically we had to consider the go prospects of profitable freights immediate after the end of the war, at least temporari In spite of this and in view of the great scienti and national interest attached to the project cruise it was decided in January 1944 to the expedition charter the ship for the purpc in question from a suitable date which to fixed as soon as the turbulent times allowe and that the charter should be calculated cover the direct cost besides depreciati and interest of the capital laid down in t ship.

The Ship

The ALBATROSS is a 1,450 tons 4-masted rgo motor-schooner of the »three island»-type, ilt of steel to the highest class of Lloyd's the Lindholmen Shipyard, Gothenburg, in 42. She is classified as a motor ship, but her sign and outfit as well as the dimensions of e rigging material etc. fulfil Lloyd's require- ents regarding sailing vessels as well. The ip has three holds. The main engine is placed t and consists of a B & W 8-cyl single-acting esel engine of 450 EHP at 315 r/m, built by e Eriksbergs Mek. Verkstads AB, Gothen- ırg. Officers' accommodation as well as mess- oms, kitchen, pantry, etc. are arranged around e engine casing on two decks. Apprentices' commodation is situated midships and con- sts of eight double cabins besides dayroom, vatories, bathrooms etc.

ain data:

ength o. a. excl. bowsprit and figure-head	71.74 m
readth extreme	11.44 m
nglish gross	1,051 tons
isplacement	2,215 »
ean draft in salt water loading 1,450 tons d. w.	4.76 m
ngine output	450 EHP
rea of sails: By the wind area	921 m²
Total area excl. spare sails	1,121 »
peed loaded (with motor only)	9 knots
resh-water capacity	93 tons
unker capacity	191 »
adius of action with motor only	abt 20,000 naut miles corresponding to abt 95 days

Financial preparations

As is well known, the ALBATROSS expedi- on was made possible by means of donations om private sources. In order to organize the ientific work within a frame financially and ractically feasible, it was necessary to draw up a detailed budget for the whole enterprise at the very beginning of the preparations.

As the expedition should not commence operations until after the end of the war, and the first plans were laid out as early as in 1943, many difficulties owing to the uncertainty connected with the war had to be overcome before a fairly reliable estimate of cost could be arrived at.

Firstly, difficulties arose from the fact that this was an exceptional task and the shipping company, therefore, had no comparable previous experience to build upon. Thus, approximate estimates and entirely theoretical calculations had to be alternated with experience.

Secondly, with regard to estimates of cost all the difficulties directly connected with the war, i. e. prices abroad for bunkers, supply of food and other necessities, as well as port dues, wages and so on, were practically unknown. Moreover, a great part of the route went through regions of the earth rarely visited. This naturally complicated matters, especially as the war for several years had cut off contacts even with our normal shipping connections in foreign countries.

The expedition cost was divided into:

1. *Cost for the ship's equipment and conversion*, viz:
   a. Delivery of the necessary mechanical apparatuses and instruments for the scientific work. (This item was to be specified by the leaders of the expedition).
   b. Installation of the above mentioned equipment and necessary structural alterations of the ship for the scientific work, as well as essential supplementary additions to the vessel itself for accomplishing the voyage. (Particulars on this item were drawn up by the owners' technical department, and estimates of the cost were gathered from various shipyards.)

c. Restoring the ship to its original condition after the expedition (for which offers were gathered from the shipyards).

2. *Salaries for the scientific staff* during the expedition (information supplied by the leaders).

3. *Running cost of ship during the expedition*, viz:

Bunkering, port charges, wages, provisions, drydocking and repair cost, deck- and engine stores, lubricating oils, cost of administration, insurances, depreciation, interest, etc.

These latter items had to be calculated by the shipowners' oil, nautical, personell, catering, technical, chartering and financial departments etc. Every one of the staff showed a great interest and worked with devotion and zeal on the responsible task of planning.

The approximate total of cost received after that the items had been summed together had to serve as a basis for estimating the expenses. As investigations were advancing, this total, of course, had to be checked, corrected and adjusted from time to time. On account of increased prices, changed collective agreements for the crew etc, it soon became evident that the calculations had to be revised, unfortunately in the direction of ever increasing cost. During the whole of the planning much care had to be taken that the prescribed upper limit of the cost should not be exceeded. There was always a great danger of this owing to the unstable financial conditions during and after the war, both in Sweden and abroad.

Formally, the financial relations between the expedition committee and the owners were to be settled by an ordinary charter party. According to this all cost (except for such equipment bought directly by the expedition committee, the scientists' salaries and some other small items) were to be paid by the owners.

Cost borne by the shipowners was divided follows:

I. Cost for conversion and equipment of t ship before the start of the expedition.

II. Running cost for the ship during t expedition.

III. Restoring the ship to its original conditi after the expedition.

The expenses under items I. and III. we more or less definite as soon as offers fro suppliers, shipyards, etc were at hand. T charges under item II., viz. operating cost du ing the expedition, were on the other ha partly unknown and liable to changes duri the expedition. These expenses had to estimated preliminarily and definitely co firmed later on. They were divided into

a. fixed daily expenses (charter) for t ship, including insurances, wages, e for officers and crew, supply of food f all on board, stores, docking, repai cost of administration, interests, e

b. running expenses, such as bunke harbour and canal dues, etc.

According to the charter party the own should place the ship at the disposal of t expedition fully equipped for the above- me tioned charter. The running cost for bunke port dues, etc was to be paid by the charter as they became known.

As these important items of expenditure w most liable to change, they had to be carefu checked during the whole expedition in or to keep track of the current situation and necessary, adjust the charterers' paymer This in order to make certain that the availa funds should cover the cost for the whole v age. It may be mentioned that it was fou to be very difficult to keep track of the ex expenses from the disbursement accounts wh by degrees during the expedition arrived fr the agents.

nerary of the expedition. Nautical preparations

Already after our first conferences with Professor PETTERSSON a program was outlined. The ıte and extent of the expedition will be clear m the table below, in which after several cussions we estimated the average speed of e ship at 7 knots and where ample time for rk at sea and stay in ports had been taken o consideration.

calculated time-schedule for the circumnavigating cruise (June 1943)

	Distance in nautical miles	Time under way days	Working time days	Time in harbour days
thenburg—Açores	2,100	12	3	1
Porto Rico	2,600	15	7	
Panama	900	5	2	2
nama—Galapagos	1,200	7	4	3
6° N Lat., 90° W Long.	400	2	2	
6° N, 140° W	3,000	18	15	
Marquesas	1,000	6	4	4
Tahiti	800	5	3	4
Hawaii	2,400	14	12	7
4° 30′ N, 167° 30′ W .	1,200	7	6	
Mindanau East Coast 6° N Lat.	4,000	24	18	
Manila (South Way) .	850	5	4	14
anila—Philippine Trench—Banda Sea—Sunda Trench—Batavia	3,900	23	50	10
atavia—Zanzibar	4,200	25	15	3
Bombay	2,500	15	10	3
Aden	1,700	10	7	2
den—Port Said	1,500	9	3	2
Gibraltar	2,400	14	8	2
Gothenburg	2,000	12		
Total	38,650	228	173	57

Total time 458 days.

As far as the bunker and the fresh-water pacity were concerned, the ship seemed pable of carrying through this navigation ogram. With regard to the average speed, owever, we were not sure whether we could lculate with 7 knots for the around-the-orld-voyage. Although the ship by means of ıe motor could make 9 knots in a smooth sea and up to 11 or 12 knots with the aid of the sails, it had to be taken into account that, owing to the rather small engine, the bad weather which at times is inevitable during such a long voyage and the fouling of the bottom, a considerable reduction in speed might ensue.

During the revision of the itinerary it was in the first place necessary to study the meteorological conditions along the proposed route. The expedition should follow the Equator or the equatorial regions, and in order to get help from the trade winds or at least to avoid being obstructed by them, the route was laid to the westwards.

An alternative itinerary, according to which the voyage should last 18 months, with an average speed of 5 knots, was compiled. However, after a thorough examination by our nautical experts as to the ship's earlier performances, especially during a one year-charter in the South Atlantic, it seemed justified to calculate with an average speed of 7 knots, especially as the ship would be light loaded and the route round the world was laid out most advantageously as to the weather. In any case, the leaders of the expedition would be able to make necessary alterations in the program.

As it was considered that the scientific work could be carried out only in fair weather, the route had to be drawn up so as to avoid regions in which the weather continually might impede work. The aim had to be to visit the various regions in a favourable season. Thus the south-west monsoon in the Indian Ocean (May to September) had to be avoided. Also the usual period for hurricanes in the West Indies (during the autumn months) should be avoided as well as July to November in the waters near the Philippine Islands and the Chinese Sea, when the typhoons are most violent. The North Atlantic had to be crossed during a season when storms did not impede all work.

Considering this, the most suitable time for the expedition was suggested to be approxima-

tely between March and the end of May the following year. On the whole, the disadvantages of bad weather would thus be eliminated.

The route was planned to pass through the North Atlantic towards the deep regions to the south of the Equator. From there it was to go to the West Indies which would be visited in June. After passing through the Panama Canal it went on to the equatorial regions of the Pacific reaching the Philippine Islands at the end of November. The Indian Ocean, especially the western part, the Arabian Sea, were to be crossed in February/March, the Mediterranean would be reached in April, and Sweden would be reached again at the end of May, about 15 months after the departure.

The capacity of bunkers, ca 190 tons, offered no difficulties in regard to the choice of bunker stations, nor did it interfere with the itinerary. A special bunker schedule was made up by the owners' oil-department before the departure. The fresh-water capacity ought to be sufficient for all crossings even if it would have to be restricted sometimes. The lower limit of the water consumption was calculated at the satisfactory amount of 60 litres per person and day. In comparison it may be mentioned that a consumption of 250 litres per passenger and day is granted on a modern passenger vessel cruising in tropical waters. The scientific work was not expected to increase the water consumption to any amount. Nor were any difficulties in getting provisions in the suggested ports anticipated.

Delay of the expedition

On the basis of our investigations the time for the start of the expedition was fixed to March, 1947. However, during the course of preparations it was found impossible to start on this date. On account of delays in the delivery of winches etc a postponement of at least four months became inevitable.

This, after all the careful planning, of course, was a heavy blow.

As the freight market still was favourab the owners thought it advisable to defer t expedition one year. However, the scienti preparations having progressed far, the lead deemed this inconvenient. It, therefore, w necessary to investigate if it were possible plan the expedition on the basis of starti from Sweden four months later. The own were, in a way, also interested in a prom accomplishment of the expedition, as th wanted to return the ship to its ori nal use.

The leaders emphasized the necessity of s ing as early as possible in the beginning of t summer of 1947. The rather extensive proj for deep-sea trawling to be carried out mai in the Atlantic would have to be put off till t end of the expedition, and the original plan action was modified so that the Atlantic w crossed directly, steering almost straight for t West Indies, visiting this area about Augus and passing through the Panama Canal so day in the middle of August. The typho districts around the Philippine Islands sho be reached about New Year, which was con nient, and the Arabian Sea in April, before arrival of the south-west monsoon. The maining work in the Atlantic was to be carr out during July, August and September.

The drawback of this plan was that the W Indies would be reached in August when th was a risk of meeting the dreaded West-Ind hurricanes. Further, too small a margin left for unforeseen events. A delay of 14 d might, for instance, imply the risk of be unable to carry through the projected worl the Indian Ocean. These drawbacks, howe were somewhat compensated by the an number of lay-days set out for the voyage. the danger did not seem to be imminent, no better alternative really existed, it decided that the expedition should be car out in conformity with this plan.

The final route is shown in plate I and be is given the final time-table.

TIME-TABLE

	Distance in nautical miles	Time under way days	Working time days	Time in harbour days	Date 1947
)eparture from Gothenburg					1/7
;othenburg—Horta	2,000	12	2		
rrival in Horta					15/7
eparture from Horta				2	17/7
Iorta—St. Pierre	2,000	12	3		
rrival in St. Pierre					1/8
eparture from St. Pierre				4	5/8
t. Pierre—Colon	1,200	7	2		
rrival in Colon				3	14/8
assing through the canal		1			
leparture from Balboa					18/8
Balboa—Galapagos	1,000	6	2		
rrival in Galapagos					26/8
leparture from Galapagos				4	30/8
Galapagos—Marquesas	3,700	22	10		
rrival in Marquesas					1/10
leparture from Marquesas				5	6/10
Marquesas—Tahiti	800	5	2		
rrival in Tahiti					13/10
leparture from Tahiti				4	17/10
Tahiti—Honolulu	2,580	16	8		
rrival in Honolulu					10/11
leparture from Honolulu				12	22/11
Honolulu—Ponape	3,280	20	9		
rrival in Ponape					21/12
leparture from Ponape				5	26/12
Panape—Mind.—Ternate	2,780	17	11		
rrival in Ternate					23/1
leparture from Ternate				3	26/1
Ternate—Batavia	1,400	8	6		
rrival in Batavia					9/2
leparture from Batavia				8	17/2
Batavia—Colombo	2,800	17	7		
rrival in Colombo					12/3
leparture from Colombo				7	19/3
Colombo—Port Victoria	1,800	11	5		
rrival in Port Victoria					4/4
leparture from Port Victoria				5	9/4
Port Victoria—Aden	2,500	15	6		
rrival in Aden					30/4
leparture from Aden				2	1/5
Aden—Port Said	1,500	10	1		
leparture from Port Said				3	15/5
Port Said—Monaco	1,500	9	5		
rrival in Monaco					29/5
leparture from Monaco				4	3/6
Monaco—Tangier	840	5	3		
leparture from Tangier				2	13/6
Tangier—Funchal	650	4	2		
rrival in Funchal					19/6
leparture from Funchal				3	22/6
Funchal—St. Vincent	1,300	7	3		
rrival in St. Vincent					2/7
leparture from St. Vincent				3	5/7
St. Vincent—Romanche Deep	1,200	7	4		
Romanche—Fernando N.	800	5	4		

	Distance in nautical miles	Time under way days	Working time days	Time in harbour days	Date 1947
arrival in Fernando N.					25/7
departure from Fernando N.				3	28/7
Fernando N—Haiti—San Juan	2,000	12	5		
arrival in San Juan					14/8
departure from San Juan				3	17/8
Haiti—Plymouth	3,500	21	13		
arrival in Plymouth					20/9
departure from Plymouth				3	23/9
Plymouth—Gothenburg	800	5			28/9
Total	41,930	254	113	88	

Average speed: 165'/day or 6.9 knots.

Conversion of the ship

Extensive conversion was necessary in order to adapt the ALBATROSS for the expedition. Bearing in mind the ships original and future task of a training-ship, this had to be executed so as to keep down expenses for the restoration of the vessel to its normal condition as much as possible.

The conversion, which was done by the Lindholmen Shipyard at Gothenburg, consisted partly of the installation of winches and other mechanical outfit necessary for the oceanographic work, and partly in building laboratories as well as working and living premises for the scientific staff and for those men accompanying the expedition in addition to the ordinary crew.

Plate II shows sketches of ship equipped for the expedition.

For these essential installations the available space on board was chiefly:

Hold No 1

The big winch for the core-sampler was mounted on a welded steel bed-plate on the tank-top. The winch was of a special design and had a hauling power of 15 tons at a speed of 0.5 m/sec corresponding to 0.8 m/sec with a load of 10 tons. The winch was connected with a cable-coiling-winch storing 12,000 m cable. This winch was also placed on the tank-top. The cable was conducted from the barrel to th grooved drums by a horizontal sheave, an through a guide-pulley at the hatchcoamin over the ship's side by means of a stron lowerable trawl-davit.

Before being mounted in the ship, the winc was tested at the manufacturers' worksho Although these tests could not be accomplishe to the limit required, they suggested son adjustments. Tests were also made with th vessel at quay which resulted in some furth alterations.

In spite of these tests and others carried o during the trial trip, the winch did not functi satisfactorily during the first part of the expe tion. Thanks to energetic and careful work b the engineers of the ship the final adjustmen were carried out on board.

Furthermore, in this hold, shelves and cu boards were built for storing large articles su as core-tubes, hauling nets, trawls, etc. Tw reserve cables for the big core-sampler we mounted on specially constructed trestles a could be rolled directly on to the barrel of t cable-coiling-winch. These cables weighed abo 7.5 tons each, and it was therefore necessary stow them so that they did not have to moved when required for use.

The explosives, to serve for exploring t thickness of the sediment, were stowed in l canisters. The fuses for these explosives we kept separate in steel boxes under the forecast

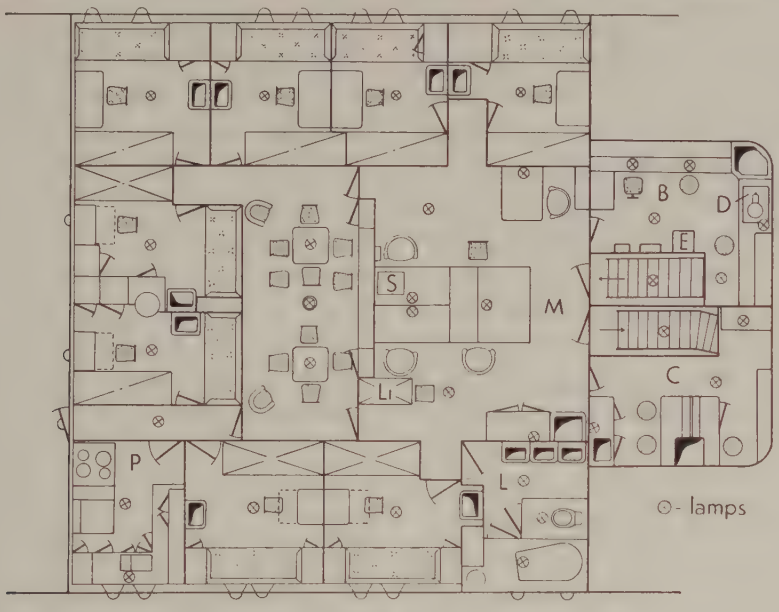


Fig. 2.

Hold No 2

Figs. 2 and 3 show in some detail how this rt of the ship was arranged.

Eight cabins for the expedition staff were ablished round the cargo hatch on the main ck. On the cargo hatch were set up a large ntral laboratory and a library. The cabins re bordering these rooms. The hatchway on the upper deck was covered by a steel skylight, and the communication to deck was ascertained by means of a staircase leading from the central laboratory through the fore part of the skylight.

All the cabins, four single and four double ones, were provided with pine furniture, consisting of a berth, a small writing-table, a bookshelf, a sofa and a chair. The cabins were

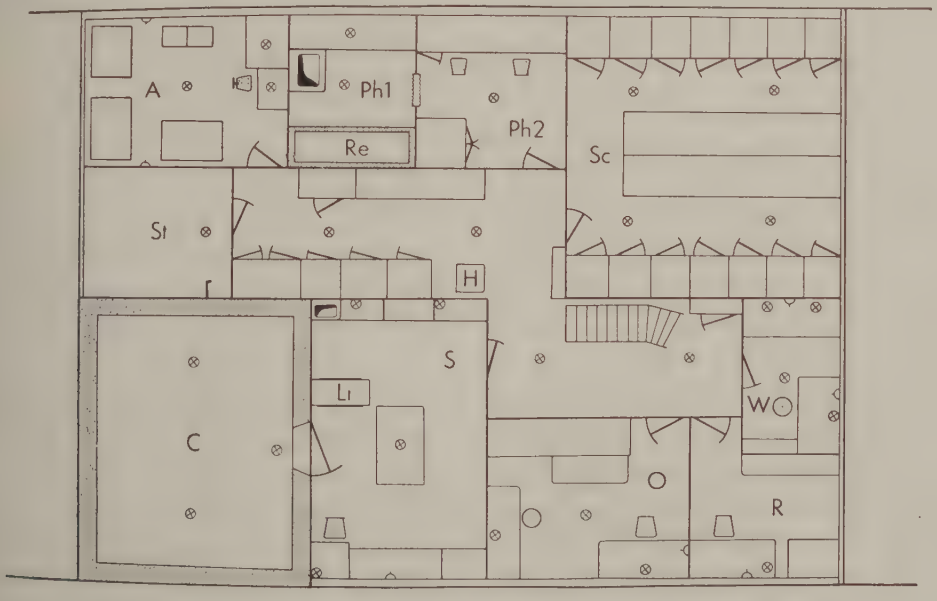


Fig. 3.

equipped with a wardrobe and a wash-stand with running water. A special wash-room with a shower-bath was also built, as well as a bath-room and a WC.

The equipment below the main deck consisted mainly of working premises, viz. rooms for sediment investigations, the radio-engineering laboratory, the optical laboratory and the aquarium. A cold-room for storing packed cores was situated close to the sediment laboratory. A small lift maintained communications between deck and the two floors in the scientific department.

In order to reduce the inconvenience of the tropical heat these departments were fitted with an air-conditioning system. It was thus possible to keep the temperature some degrees lower than the exterior temperature.

Hold No 3

This hold was arranged as a supplementary engine room. A door was inserted in the bulkhead for convenient communication with the ordinary engine room.

In this room a dynamo set was mounted which delivered power for the big winch. The dynamo was a 130 kW Leonard generator, directly connected to a diesel engine of 200 HP. The unit was mounted on a seating welded on the re-inforced tank-top. Oil and compressed air to the diesel engine was obtained through pipes from the ordinary engine room abaft.

In the fore part of the hold were installed the supplementary refrigerating machines necessary for the air-conditioning plant as well as for the cold-room for sediment cores.

Accommodation aft

An additional number of officers, as well as an increase of the catering department were required during the expedition. In order to provide rooms for these some alterations were carried out in the accommodation aft. A combined navigation and wheel-house was built on the deck-house forward of the mizzen-ma
In the place of the previous wheel-house, in
fore part of the deck-house, two new cabins
officers, a hospital and the radio telegraph s
tion were installed. The existing cabins be
deck were altered so that space was obtai
for the whole staff.

Deck

The space available on deck was chie
utilized as follows:

In the forward Starboard well was placed
lowerable trawldavit which served the wi
in the hold. On the bulwark close to the da
a platform was arranged from which work w
the sampler was directed. Another platfo
was built at the gunwale on the deck-ho
where a contrivance was made for horizon
fixing of the 20 m coresampler. The ca
derricks abaft the main mast and forward
the mizzen-mast were intended to facilitate
taking-in and rigging-out of the sampler.

As the big winch with its strong cable
designed also for deepsea trawling, shea
were arranged on deck so that the cable co
be conducted over the gunwale astern.

A winch for operating the bathythermogra
was mounted on Port side of hatch No 1.
instrument was submerged from a da
mounted on the gunwale.

The hydrographical winch and the »Lu
sounding machine were placed on Port side
the midship deck. The hydrographical wi
was fitted with a cable barrel for 12,000 m c
with a diameter of 4 mm, and had a lif
capacity of 1,000 kgs at a speed of 1 m/
Davits served to clear the cable from t
apparatuses from the ship's side. The w
bottles were attached and detached from
cable from a removable platform.

For biological investigation such as traw
at small depths, dredging etc one of the c
winches at the mizzen-mast was provided
an enlarged cable-barrel which could sto

00 m long and 9 mm thick cable. Suitable itch blocks and fairleads conducted this ble over the stern.

A winch for the measurement of the sub-rine light was placed in the ship's stern on e poop deck. The instruments were sub-rged from the end of a 5 m crane-arm ounted at the gunwale in order to bring the struments out from the shadow of the vessel d the rig.

Other equipment included two light-photo-eters at the end of the jib-boom and a wind-uge at the top of the main mast. These struments were connected with recorders in e laboratory. The Hughes' echo-sounder, hich was able to record the greatest ocean pths, was also mounted in one of the labora-ies. A special tank on Port side of tank No 3 s arranged for the transmitting and receiving embrane.

Bunkers, fresh-water and provision stores, etc

The ship's capacity of bunkers, 191 tons sel oil (admitting a radius of action of about ,000 nautical miles) and the fresh-water pply of 93 tons were sufficient for conditions et with during the expedition. The provision ores had to be increased with some rooms in e new-built accommodation in hold No 2. An additional lifeboat for 25 persons, fur-shed with a 10 HP diesel engine was placed cargo hatch No 3. The boat was intended to rve for communication with land and was sily launched with the aid of the cargo derrick the mizzen-mast.

Ballast

Fixed ballast had to be placed on board to ve the vessel proper trim. For this purpose atforms 2 m below the main deck were built the fore part as well as in the after part of ld No 1. On each place 100 tons small paving ones were placed. A similar platform was constructed in the fore part of hold No 3 where also 100 tons stone were placed. Finally, a small bin was built on each side above the gutters in the aft part of hold No 3, where the total amount of 60 tons crude iron was stowed.

Fig. 4 shows the stability conditions of the vessel during the expedition.

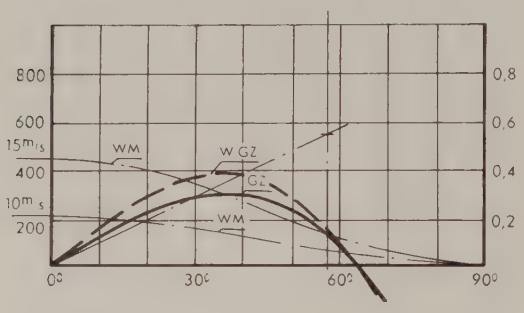
All the planning of these extensive tasks with specifications, drawings, offers, orders, working control, etc was carried out by the technical department of the owners in close collaboration with the leaders of the expedition and the shipyard. As experience with these things was lacking, every detail had to be studied carefully, and accurate tests of the equipment, machines and apparatuses had to be carried out. Although the tests were most thorough and often seemed almost too rigorous, it must be conceded that in some cases they were found to have been too scanty. Delays and difficulties of delivery at the time of conversion further complicated the work.

The conversion was started at the Lindholmen yard on March 28, 1947 and was practically finished by the 25th of June. In order to test the big winch under realistic conditions, a trial trip was made on the following days to the deepest locality in the Skagerrak, situated about 45 miles north-west of Skagen. Here the core sampler was tested and deep-sea trawling at a depth of 700 m was tried. After the return some small adjustments were carried out on the basis of the experience gained. The ship was definitely ready to commence the expedition on July 4, 1947.

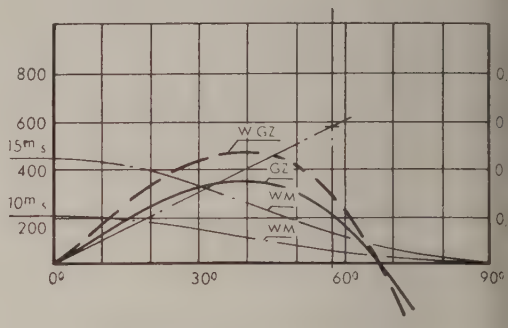
Crew

According to the charter party the ship should be delivered to the charterer fully equipped and manned. Officers and crew should be at the disposal for operating sounding apparatuses and other technical work required by the expedition. The scientists were to be signed on but were not to be considered as employed by the shipowner.

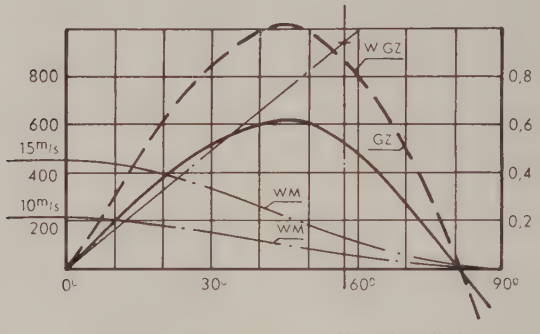
Curves of stability for ALBATROSS as a research—vessel



Empty ship



Ship fully equipped, with empty tanks



Ship fully equipped, with all tanks filled

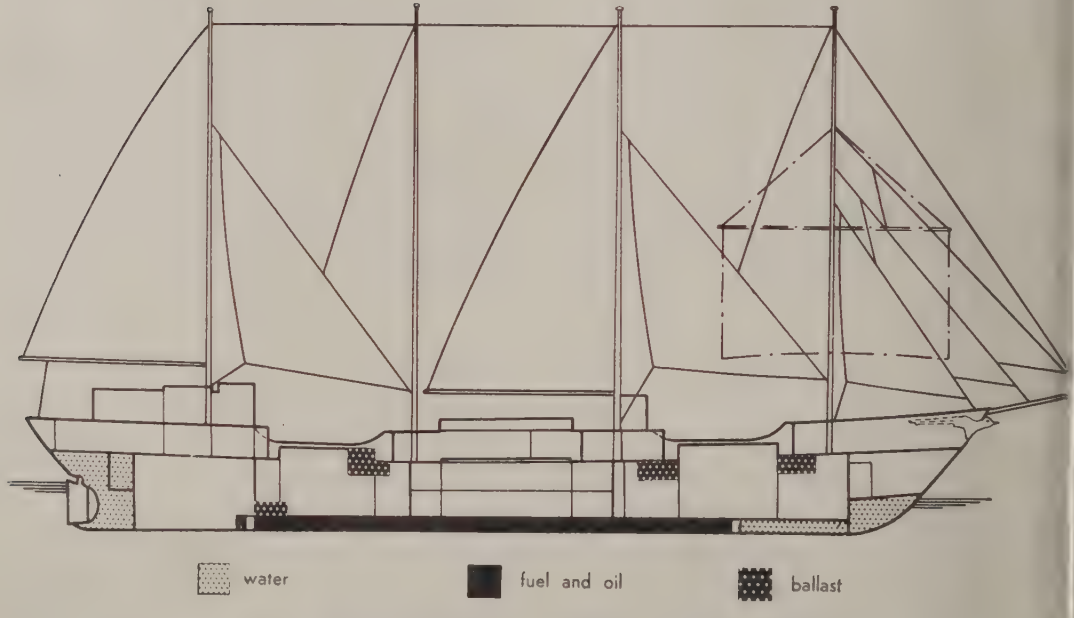


Fig. 4. Sketch showing places of water, oil and fixed ballast

N. Å. Th. Krafft

A list of the crew was made up by the owners' rsonell department according to the assumed sks on board. At the departure from Gothen- rg this list included the following names:

aster ..... N. Å. Th. Krafft

ECK

ief officer ..... A. L. B. Kylgård
d officer ..... E. F. Eriksson
d officer ..... Th. Å. G. Röing
rpenter ..... T. W. Vallin
aman ..... H. V. Kvist
aman ..... N. L. Skoog
aman ..... B. G. A. Lindstedt

NGINE

ief engineer ..... H. B. E. Envall
xpedition engineer ... A. O. E. Gynnmark
t engineer ..... K. R. Armandt
t motorman ..... O. H. Forsberg

ATERING DEPARTMENT

eward ..... S. Å. Svensson
t cook ..... T. G. Holm
d cook ..... Y. H. Johansson
aiter ..... J. R. Sundin

APPRENTICES

S. E. G. Högberg
C. B. G. Landén
K. Th. Larsson
H. E. Lovén
P. E. T. Lundberg
L. D. Nordberg
K. R. Palm
K. E. Ringblom
B. G. Sjödin
P. A. E. Ståhl
G. A. Svensson
B. E. G. Söderström

The 2nd and the 3rd officers also acted as radio operators.

THE SCIENTIFIC STAFF of 12 persons was added to the crew. Among them Dr John Eriksson who also functioned as the ship's physician.

The master, officers and engineers, the steward, and the 1st cook were quartered in the accommodation aft.

The carpenter and motorman, the 1st cook's assistant, the seamen and the apprentices were quartered in the apprentices' accommodation midships.

The scientific staff was quartered in the new accommodation on main deck.

The following reserve premises were also at disposal:

a. hospital astern with two berths,
b. a single cabin astern,
c. one spare berth in a double cabin astern.

H. B. E. Envall

According to the training principles the apprentices should alternate in service between deck, engine and catering departments, so that they spent about the same period of training in each. The distribution was as a rule seven on deck, three in the engine room and two in the catering departments. Two men with long practice of sounding and trawling work etc from the research-ship »Skagerrak» were signed as sailors.

Provisions

As the ship was provided with modern refrigerating plants, the supply of fresh provisions, meat, fish, poultry, butter, etc taken on board was sufficient for about two months. In view of the fact that the longest period at sea, according to the navigation program, would be only 21 days, the margin must be considered as fairly satisfactory. A great advantage was that the cold-room for sediments, which at the beginning of the journey was empty, and meant to be gradually filled up, could serve for storing perishable tinned provisions.

At a preliminary discussion on the provision question with Professor PETTERSSON, we were asked to investigate whether some firms might be interested in presenting provisions to the expedition for testing their storing capacity. A list of suggested firms was handed over to Professor PETTERSSON who contacted them himself. This resulted in the ship obtaining a valuable supply of various tinned goods such as meat, herring, fish and vegetables, and of Swedish rye-bread, biscuits, chocolate, beer, refreshing drinks, etc partly delivered in packets suitable for tropical use.

The ALBATROSS was provisioned — apart from the goods presented and by the fresh articles — with a quantity of provisions which was almost twice as large as that taken on board a 10,000 tons ship of the Swedish East Asia Company for a five months voyage to the Far East. The total quantity of provisions on board at the start amounted to 12,850 kgs (exclusive of beer and refreshing drinl Among the main articles may be mention

Tinned vegetables	825
» herring and fish	480
» meat	508
Lingonberry jam	300
Swedish rye-bread	500

Such articles as rye-bread, some tinned p visions etc, which are difficult to get abro were taken on board in Gothenburg to suf for the whole trip round the world.

As it was deemed unlikely that new potat could be obtained in the Pacific, the ship provisioned with dried potatoes, which w consumed during this part of the journey.

In view of the rather exceptional circu stances, the owners' catering department s gested, as a guide for the steward, a spe purchase program for the route planned.

Drydockings

As the ship should sail in the tropics dur the whole time and for periods being stop in warm waters, two drydockings were fores during the expedition. Honolulu, where a days stay was planned at the end of Novem and Colombo, which according to the ti table should be reached in the middle of Ma were suggested as the most suitable places. definite arrangements naturally were postpo till the expedition was being carried out.

Other preparations

In order to carry out such a complica enterprise as an oceanographic expedition ro the world, representatives able to take car the interests and current affairs of the shi a rapid and efficient way were needed along route. Apart from the necessary replenishr of material and equipment, unforeseen dam might occur, replenishment of the crew m have to be carried out, a sick person sent h etc.

n the main ports, at the Panama and the z Canals etc, ordinary agents and other nections of the Broström Concern were, of se, at our disposal. But many of the places re the ship should call, were situated far y from the ordinary routes, and some out- s were practically uninhabited. We as- ained, by connections in neighbouring ports, t was to be done when the ship called. For rest it was left to the discretion of the master ct in the best way in the ship's interest, and ecessary consult the owners by telegram.

n ample time before the expedition the agents question were notified about the planned of the ship, the general purpose of the edition, etc. Some special problems had also e dealt with at an early stage. For instance, ship carried explosives for sediment in- igations and inquiries had to be made as whether difficulties would arise with regard hese. The possibility of getting reductions arbour dues, on account of the character of expedition, was also investigated by the nts. We are anxious to emphasize that all e agencies, as well as officials at the different es, showed great consideration and interest.

How the calculations turned out

ll the estimates of such a unique and ensive enterprise as the ALBATROSS expe- on, of course, had to be calculated with a siderable uncertainty. The detailed delibera- ns were not supported by any earlier experi- es of the same kind and, consequently, the rces of errors were many. This as well in ard to the economic calculations as to the mated average speed, time needed for ntific work, repairs, wear and tear of the , engine, crew, etc.

The cost

Under »Financial preparations» the difficulties nected with the economic calculations were mentioned. The years immediately after the war showed enormously increased costs for international sea-trade viz. increased bunker cost, higher salaries for the employees on board, more laydays, increased cost of repairs, etc. It is evident that the running cost of the expedition was greatly influenced during a fifteen months' voyage. Under the circumstances it was impossible for any owner to run his ships within the calculated estimate of cost. The expedition was severely affected, and it was under the conditions present found almost impossible to make the economic calculations within a reasonable margin.

The itinerary

On the whole it must be said that the ship at sea well kept to the schedule. However, the laydays in port became more than estimated, chiefly because considerably more time was required for overhaul and repairs than was anticipated. In addition it also became evident that the distances calculated between the ports were too small. Due regard had not been taken to the fact that the ship must reach fixed points for research work and so it was not possible to beat up against the wind as favourably as could have been done during an ordinary voyage.

At the departure from Honolulu on December 14 the ship was 22 days late. This delay had to be caught up before the Indian Ocean was reached. The call at Ponape, therefore, was omitted, and the ship went directly to Ternate, a distance of about 5,300 miles or 43 days; the longest period at sea during the whole trip. Thus, the delay, which did not increase in the Indian Ocean, was reduced to 3 days. At Monaco, in May, the ship had caught up with the schedule.

Thereafter the ship was able to follow the program, although some harbour visits had to be left out and the route had to be straightened out in the last part of the Atlantic. Towards

the end of the trip the growth at the bottom of the vessel reduced the speed somewhat.

The ship was drydocked in Honolulu (according to plan) and in Suez. The ship turned out to have a fairly strong bottom-fouling. To avoid such a handicap while crossing the Atlantic, it was decided to dock the ship a second time at the most suitable place, viz. Suez. The ship returned to Gothenburg on October 3 as planned, after a seven days' stay in London during which time a large number of scientists and other interested persons were received on board. In spite of the reduction in the route, compared with the original plan, the total distances sailed amounted to 45,000 miles, i. e. about 3,000 miles more than anticipated. The ship had spent 354 days of the 456 cruise at sea.

Reconversion of the ship to its ori state

After returning to Gothenburg the ship for some days, at our disposal in order to the equipment, the laboratories etc to inter persons, in connection with which the scie demonstrated their specialities. On Octo the ALBATROSS was taken to Lindhol yard to be reconverted to her original cond which, together with other necessary re was finished on December 11, 1948 whe began to take in cargo for England.